Performance of Shower Deconstruction as a top-tagger using the ATLAS detector

Nicolas Gilberto Gutierrez Ortiz

nicolas.gilberto.gutierrez.ortiz@cern.ch

Shower Deconstruction

Using subjets to probe the substructure of a large-radius jet, shower deconstruction [1] assigns a probability based on an approximate parton shower model, that the jet originated from a massive particle.

For a given collection of subjets, $\{p\}_N$, this algorithm constructs a discriminant, χ_{SD}, given by :

$$\chi_{SD}(\{p\}_N) = \frac{P(\{p\}_N|S)}{P(\{p\}_N|B)} = \frac{\sum_{histories} P(\{p, c^j\}_N|S)}{\sum_{histories} P(\{p, c^j\}_N|B)}$$

where subjets are assigned to categories, c^j, for a given shower history, $\{p, c^j\}_N$, that is tested against signal (S) and background (B) hypothesis.

Two example shower histories, out of more than 1500, are shown for a particular large-R jet.
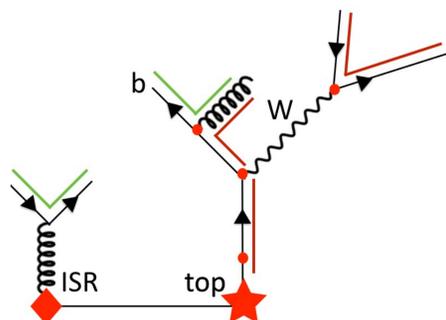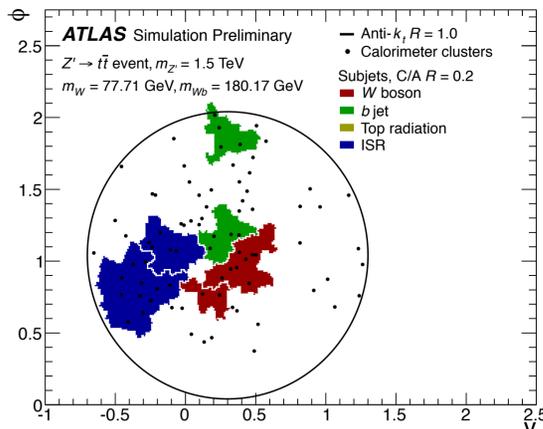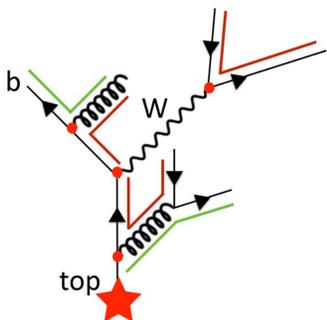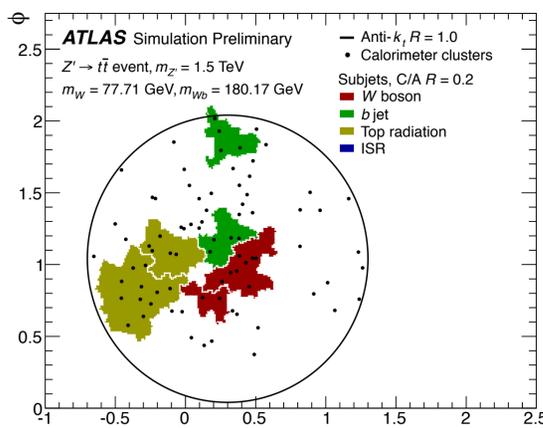
Subjets and composite jets

The constituents of an anti-k_t R=1.0 jet are clustered into C/A subjets with a radius parameter of 0.2. Subjets with p_T < 20 GeV are discarded.
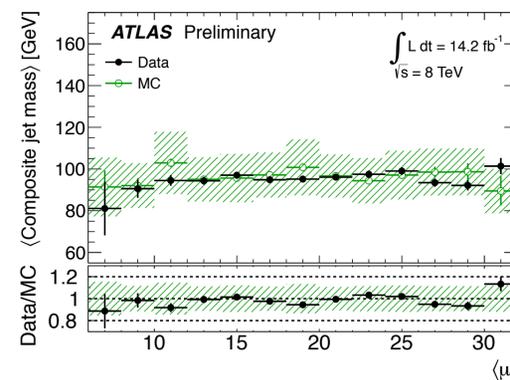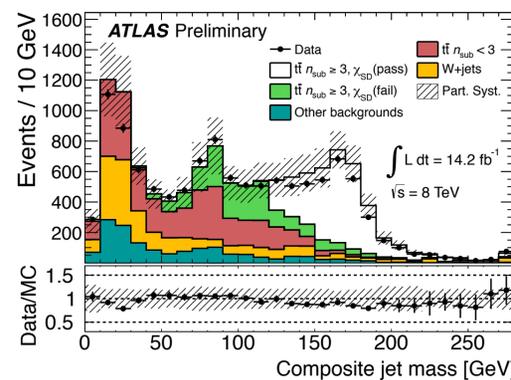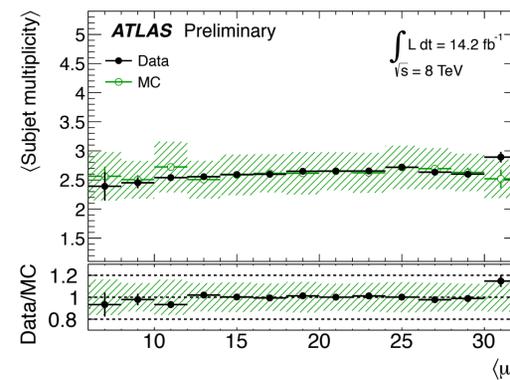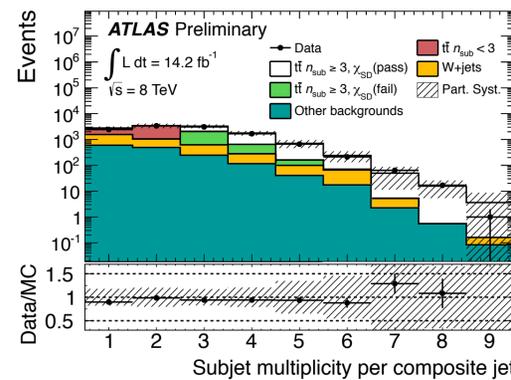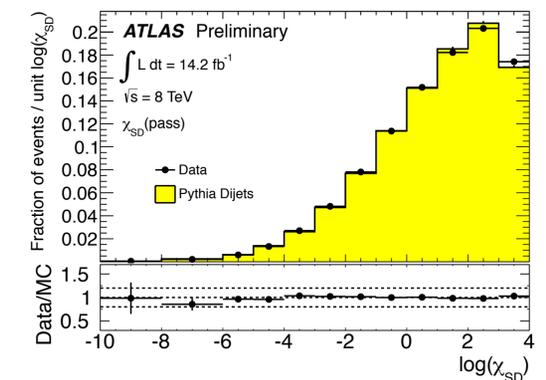
χ_{SD} in top pair production events

χ_{SD} of the leading large-R jet with p_T > 300 GeV is shown for events with one lepton, MET, a b-tagged jet [2]. This observable shows little dependence on pileup.
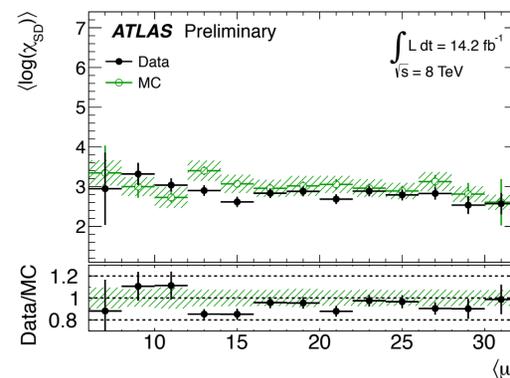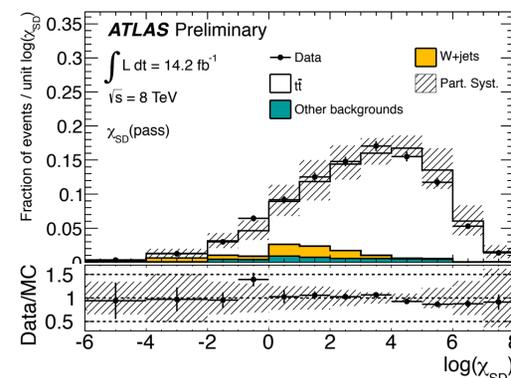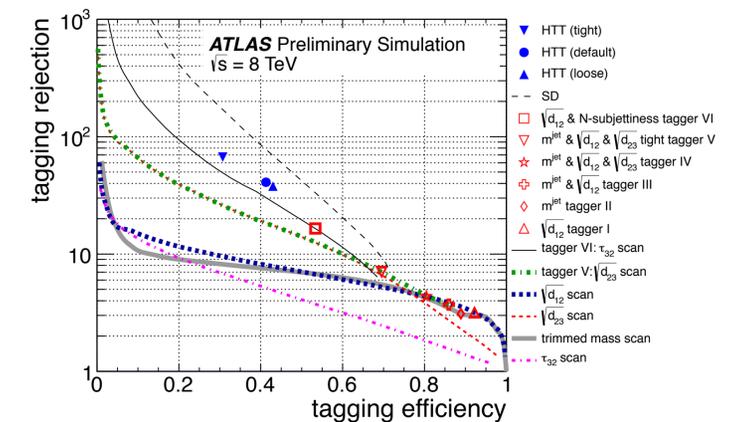
χ_{SD} in dijet events

χ_{SD} is shown for the leading large-R jet with p_T > 500 GeV.

Boosted top tagging

Shower deconstruction shows the best background rejection over a wide range of top-jet signal efficiencies.

Bibliography

[1] D. E. Soper and M. Spannowsky, *Finding top quarks with shower deconstruction*, arXiv:1211.3140 [hep-ph].

[2] ATLAS Collaboration, *A search for ttbar resonances in the lepton plus jets final state with ATLAS using 14 fb^{-1} of pp collisions at $\sqrt{s}$ = 8 TeV*, ATLAS-CONF-2013-052.

[3] ATLAS Collaboration, *Performance of boosted top quark identification in 2012 ATLAS data*, ATLAS-CONF-2013-084.

[4] ATLAS Collaboration, *Performance of shower deconstruction in ATLAS*, ATLAS-COM-CONF-2013-140.